DETAILED END-TO-END SIMULATIONS OF A LOW-SWIRL LABORATORY BURNER

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With adaptive-grid computational methodologies and judicious use of compressible and low Mach number combustion models, we are carrying out three-dimensional, time-dependent direct numerical simulations of a laboratory-scale low-swirl turbulent premixed methane burner. In the laboratory experiment, turbulence is generated by a grid located in the throat of a 50mm diameter circular nozzle; swirl is introduced by four tangential air jets spaced uniformly around the circumference of the nozzle just above the turbulence grid. A premixed methane flame is stabilized above the nozzle in the central core region where a velocity deficit is induced by the swirling flow. The time-dependent flow field inside the nozzle, from the turbulence grid and the high-speed jets, to the nozzle exit plane is simulated using an adaptive-grid embedded-boundary compressible Navier-Stokes solver. The compressible calculation then provides time-dependent boundary conditions for an adaptive low Mach number model of the swirl-stabilized premixed flame. The low Mach model incorporates detailed chemical kinetics and species transport using 20 species and 84 reactions. Laboratory diagnostics available for comparisons include characterizations of the flow field just down stream of the nozzle exit plane, and flame surface statistics, such as mean location, wrinkling and crossing frequencies.